

**INVENTORY AND MONITORING OF HERPETOFAUNA IN THE DISTRICT
OF COLUMBIA**

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ABSTRACT

The District Wildlife Action Plan was developed in 2001 and the District Department of the Environment, Fisheries and Wildlife Division, is responsible for implementing the plan. The purpose of the District herpetofauna survey is to monitor the condition of herpetofauna populations in order to better conserve species of greatest conservation need and their habitats. Currently, there are a total of 38 reptile and amphibian species listed at species of greatest conservation need in the District (22 and 16 respectively). The 2007 and 2008 surveys worked towards these objectives, and the 2009-2010 surveys furthered the objectives, but information on the population and diversity of herpetofauna is still needed. The purpose of the 2011 study was to continue conducting surveys to monitor the herpetofauna in the District. A variety of methods were implemented in this study in order to encompass a greater diversity of herpetofauna, thus, establishing monitoring protocols.

Keywords: Wildlife Action Plan, Herpetofauna, Surveys, Inventory, Monitoring

INTRODUCTION

Herpetofauna is a term to relate to the reptiles (snakes, lizards, and turtles) and amphibians (frogs, toads, salamanders, and sirens) of a given area. Both reptiles and amphibians are on a global decline due to many factors such as habitat loss and degradation, invasive species, environmental pollution, and disease (Gibbons et al. 2000). Reptiles and amphibians are key biological indicators as they are in close contact with water and soil, and any toxins can be absorbed through the skin (especially in the highly permeable skin of amphibians). Also, most have small home ranges, making it hard to avoid disturbances.

With a global decline of amphibians and reptiles, due to factors such as habitat loss, invasive species, environmental pollutants, and disease, much attention has been paid to conservation efforts of the species (Gibbons et al. 2000; Row and Blouin-Demers 2006). Reptiles and amphibians are key biological indicators as they are in close contact with water and soil, and any toxins can be absorbed through the skin (especially in the highly permeable skin of amphibians). Also, most have small home ranges, making it hard to avoid disturbances. And according to the DC Wildlife Action Plan (WAP), over half of the amphibian and reptile species located in the District are listed as species of greatest conservation need (SGCN) (Chapter 3, pp46-47). With their habitat being infringed upon by human activity, it is important to understand where these species live and the habitat they require to survive in order to prevent further decline (Corn and Bury 1990).

Locating amphibian and reptiles can be a complex task given their cryptic nature and therefore, monitoring their populations can be difficult (Mazerolle et al. 2007). The key to generating an inventory comes from knowing the habitat each the species requires and implementing a number of different sampling methods (Scott 1976). Once the species are located and documented, the task of monitoring the population and restoring habitat becomes slightly less daunting.

Along with the goals of identifying species and their habitats and increasing the understanding of these species, the goals of the WAP are to conserve species and their habitats, create partnerships with other leading conservation agencies, educate and engage the public in the understanding of conservation needs, and to strengthen the current conservation actions and regulations (District Department of the Environment, WAP 2006). With these goals, the WAP acts to save species from becoming endangered or extinct and work towards getting funding to protect species that have not historically been given funding (District Department of the Environment, WAP 2006).

Inventory Sampling Methods

Sampling for herpetofauna species took place from March through October 2011. Sampling for each species type involved various types of methods in order effectively begin monitoring species.

Radio-telemetry of *Clemmys guttata* in the District of Columbia.

Introduction

Clemmys guttata (Spotted Turtle) is listed as a species of concern in every state that it is found and is federally listed as a vulnerable species (IUCN 2009). Within the District of Columbia, the spotted turtle is critically imperiled (WAP Chapter 6; p. 64; District Department of the Environment 2006). Because of their status, they are a priority species of study in order to determine their locations, movements, and activity within the District. In 2009, *C. guttata* had been captured and released in the U.S. National Arboretum during the freshwater turtle trapping and had been seen on two separate occasions at Kenilworth Park and Aquatic Gardens.

Survey Protocol

Turtles were to be captured by hand or dipnets, measured (carapace length and width and plastron length and width), weighed, and fitted with PD-2 (Holohil Systems Ltd., Woodlawn, ON, Canada) transmitters before being released (Haxton and Berrill 2001). Transmitters were to be mounted to the carapace with PC-7 slow drying epoxy, just above a back leg. Transmitters and epoxy weigh approximately 12g and turtles were not to have transmitters mounted with the weight exceeds 5% of their body weight. The turtles were to be tracked using TRX-16S-Rech receiver and 3-element folding Yagi antenna (Wildlife Materials Inc., Murphysboro, IL) 2-3 times weekly until they enter hibernation (March/April to November) and once weekly during the winter months (November to March; Haxton and Berrill 2001).

Results

Turtles were searched for during the active months (April-June). No *C. guttata* were found.

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Night time frog call surveys in the District of Columbia.

Introduction

Frogs and toads are often times very cryptic and difficult to visually locate. Using surveys based on vocalizations during the breeding season can be used to determine the presence/absence of species and the proportion of area occupied (PAO).

Previous studies have been centered on the Chesapeake and Ohio Canal and Rock Creek Park within the National Capital Region, identifying amphibians as a priority group that required long-term inventory and monitoring (Mattfeldt, Grant, and Bailey 2007). Research for this extensive monitoring began in 2005, with the goal to document 90% of the amphibian species located within the National Capital Region, specifically the Chesapeake and Ohio Canal and Rock Creek Park (Mattfeldt, Grant, and Bailey 2008).

Other amphibian monitoring has been based in Maryland. These studies have followed protocols based from the North American Amphibian Monitoring Program (NAAMP), and focused on models to determine anuran detection and site occupancy based on anuran calling as outlined by the United States Geological Survey Amphibian Research and Monitoring Initiative (USGS-ARMI; Weir et al. 2005).

Survey Protocol

Frog calls were conducted from March through June following the North American Amphibian Monitoring Protocol (NAAMP). Routes were set in the Chesapeake and Ohio Canal, National Capital Parks East, Fort Lincoln and Kingman and Heritage Islands, and the U.S. National Arboretum. Routes were established prior to surveying and remained the same throughout the survey period. Each route was run a minimum of once monthly from March through June, giving preference to nights following rainfall. Surveys were not conducted during heavy rainfall or below the set temperature parameters. Any amphibians seen crossing roads were also noted. Additional information collected for occupancy estimates included wetland type, the hydroperiod of the wetland, distance to the road, and distance to the trail. Information collected for detection probabilities included ambient temperature, sky and wind codes, moon phase, noise index, the number of cars that passed during the survey, and minutes after sunset.

Results

There were a total of six species heard calling during surveys: *Anaxyrus americanus* (American Toad), *Anaxyrus fowleri* (Fowler's Toad), *Hyla versicolor* (Gray Treefrog), *Lithobates catesbeiana* (American Bullfrog), *Lithobates clamitans* (Green Frog), and *Pseudacris crucifer* (Spring Peeper). Species and their locations can be found in Table 1. Occupancy and detection probability of the six frog species heard calling through the season were estimated by running models with different site and sampling covariates in program PRESENCE (Hines 2006) to determine which factors had an effect on occupancy and detectability of the species. Because of the numerous models run, the top five models for each species were selected based on Akaike's Information Criterion (AIC) values (Appendix C). In general, the top models differed only by the inclusion or exclusion of a few factors.

Detection Factors. - In the top five models for all species, the date of the survey explained the variation in detection for all of the six species, accounting for the seasonal variation within the anuran breeding season. The phase at which the moon was in was found to explain variation in detection for five out of the six species documented. The temperature, minutes after sunset, and noise explained the variation in one of the six species.

Occupancy Factors. - In the top five models for all species, the hydroperiod of the wetland explained the variation in occupancy for seven of the eight species heard calling. This variation would be expected as the seasonal pools have a shorter hydroperiod and dry up earlier in the season, thus, not being occupied by species. The type of habitat surrounding the wetland, distance the wetland was to the road and having a constant for occupancy rather than any factors ($\psi(.)$) accounted for variation in four out of the six species heard calling.

Literature Cited:

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Inventory and monitoring of herpetofauna in the District of Columbia.

Introduction

Inventorying and monitoring of herpetofauna should begin in the spring when most species are starting to emerge, and continue through the summer and early fall months, when activity is greatest (Karns 1986). The types of species and how many largely depends on many other factors such as temperature, rainfall, time of day, and the habitat being surveyed (Karns 1986). For these reasons, baseline inventories of herpetofauna often requires more than one type of survey in order to locate and document as many species as possible are located.

In the District, previous herpetofauna information is limited a few report from the Chesapeake and Ohio Canal and Rock Creek Park in the National Park Service's NPSpecies database (<https://science1.nature.nps.gov/npspecies/web/main/start>). Other than limited inventories, most of the information has been centered on amphibians and amphibian breeding. In 2009, the Fisheries and Wildlife Division (FWD) began inventorying the of herpetofauna in the District more closely and further surveys were necessary to collect further herpetofauna inventory data and continue monitoring populations through the 2011 season.

The purpose of the inventory and monitoring surveys in 2011 were to continue survey methods in order to encompass a larger amount of herpetofauna species that may not all be attracted to similar types of traps or covers. Trap nights and search time during field visits were based around locating and documenting the greatest number of species

possible. Although targeting all species, SGCN and the habitats they were located in were significant finds.

Survey Protocol

Visual Encounter/Egg Mass Surveys

Egg mass surveys can indicate the presence of amphibians such as *Rana sylvatica* (Wood Frog) and *Ambystoma maculatum* (Spotted Salamander). Egg mass surveys were conducted twice, from March through April, during the breeding season for these seasonal pool obligate species. Surveys took place during the day and used two observers that circumnavigated the wetlands in the same direction. Each observer recorded the number and species of all egg masses, keeping data from the first half of the pool separated from the second half. The data was compared and the highest number of positively identified egg masses recorded for each half was used for data analysis (Mattfeldt, Grant, and Bailey 2008). Additional information collected for occupancy estimates included wetland type, the hydroperiod of the wetland, flood potential, distance to the road, and distance to the trail. Information collected for detection probabilities included ambient temperature, water temperature, sky and wind codes, observer, canopy cover, percent aquatic vegetation, pH, and turbidity. During September and October, areas were visited to look for the presence of *Ambystoma opacum* (Marbled Salamander).

Artificial Cover Surveys

Reptiles and amphibians frequently take cover under objects such as logs, boards, and rocks; therefore adding artificial cover to their habitats increases the probability of encountering many species (Fellers and Drost 1994; Kinkead 2006). Coverboards (0.6m x 0.6m cut pieces of plywood) were set up in grids (Kinkead 2006). The points of coverboard placement were marked with a GPS for future reference. The boards were checked an average of seven times from April through October, with more frequent checks allowing for a greater detection of species. Species were measured for total length and/or SVL and weighed.

Results

Visual Encounter/Egg Mass Surveys

A total of 10 wetlands were surveyed for egg masses during 2011 at the Chesapeake and Ohio Canal. Each site was surveyed twice between March and April, with the exception of wetlands that had dried before the second survey.

During the visual encounter/egg mass surveys, two species of egg masses were detected: *Ambystoma maculatum* (Spotted Salamander) and *Lithobates sylvatica* (Wood Frog). Locations of species can be found in Table 2. Occupancy and detection probability of species were estimated by running models with different site and sampling covariates in program PRESENCE (Hines 2006) to determine which factors had an effect on

occupancy and detectability of the species. Because of the numerous models run, the top five models for each species were selected based on Akaike's Information Criterion (AIC) values (Appendix C). In general, the top models differed only by the inclusion or exclusion of a few factors.

Detection Factors. – In the top five models for *A. maculatum*, sky, pH of the wetland, and air temperature explained the variation in detectability between sites. In the top five models for *L. sylvatica*, water temperature and the observer explained the variation in detectability.

Occupancy Factors. – In the top five models for both species, occupancy was either constant for all sites or distance of the wetland to the road explaining the variation in occupancy across sites. Flood potential of the wetland was added as a factor because prior to surveying, heavy rains flooded several wetlands to the river, which may explain whether or not the site was occupied in the case of *A. maculatum*.

Artificial Cover Surveys

Artificial cover boards were placed in 2 locations at the Chesapeake and Ohio Canal that were randomly selected based on habitat stratification. There were a total of six habitats, and five artificial cover plots were placed in each habitat throughout the District. The habitats included: Dry-mixed hardwood forest (DMHF), wet-mixed hardwood forest (WMHF), dry evergreen forest (DEF), wet evergreen forest (WEF), dry meadow shrub-scrub (DMSS), and wet meadow shrub-scrub (WMSS). At the Chesapeake and Ohio Canal, arrays were set up in DMSS and WMHF.

There were a total of two species were found during the artificial cover surveys. Species and their locations can be found in Table 3. Occupancy and detection probability of the species were estimated by running models with different site and sampling covariates in program PRESENCE (Hines 2006) to determine which factors had an effect on occupancy and detectability of the species. Because of the numerous models run, the top five models for each species were selected based on Akaike's Information Criterion (AIC) values (Appendix C). In general, the top models differed only by the inclusion or exclusion of a few factors.

Detection Factors. – In the top five models, detection of the two species was effected by whether or not there was rain during the survey. For one of the species, the wind speed, the amount of canopy cover, the temperature, and having p as a constant (p(.)) influenced detection.

Occupancy Factors. – For both species, occupancy was influenced by having psi as a constant (psi(.)). The distance of the wetland to the trail and the road explained occupancy in only one of the species.

Incidental Observations

Several species were noted while conducting different surveys at the sites. A list of these species and their locations can be found in Table 4.

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Turtle trapping mark-recapture population estimation in the District of Columbia.

Introduction

Estimates for aquatic turtle populations are often obtained by visually observing basking turtles or physically trapping turtles. The downside to visually observing turtles is that many are shy and will move into the water before properly identified and distinguishing between species can be difficult when the carapaces are dry. Also, there are several species of turtles that do not bask. For these reasons, population estimates were based solely on mark-recapture methods from trapping, thus allowing for future recognition and monitoring.

Survey Protocol

Aquatic turtles were inventoried by the mark-recapture method using hoop nets (Memphis Net and Twine, Memphis, TN). Nets were submerged under water, leaving enough of the trap exposed so trapped turtles are able to come up for air. Traps were placed parallel to the shoreline and rotated, as to reduce trap shyness. Traps were baited with fish and checked daily. Turtles were measured for plastron and carapace lengths and widths, weighed, sexed (if possible), marked, and released. A three edge taper file was used to mark the marginal scutes on the turtles.

There were a total number of 18 trap nights occurred at the Chesapeake and Ohio Canal during the 2011 season. Species present included: *Chelydra serpentina* (Snapping Turtle), *Trachemys scripta elegans* (Red-eared Slider), *Chrysemys picta picta* (Eastern Painted Turtle), *Sternotherus odoratus* (Musk Turtle), and *Pseudemys rubriventris* (Redbelly Turtle). Of these five species trapped, three are SGCN. Actual numbers of species caught at each site can be found in Figure 1.

C. serpentina was still the most abundant species trapped, followed by *P. rubriventris*. There was an increase in the number of *S. odoratus* trapped than in previous years, and the numbers of *T. scripta elegans* were still low.

Literature Cited:

White, G.C. and K. P. Burnham. 1999. Program MARK: Survival estimation from populations of marked animals. Bird Study 46 Supplement, 120-138.

**APPENDIX A
TABLES**

Table 1. Nighttime frog call survey locations and species in the District, 2011. X indicates species was heard calling at that location.

Species	National Arboretum	Chesapeake and Ohio Canal	National Capital Parks East	Fort Lincoln	Kingman and Heritage Island
<i>Anaxyrus americanus</i>	X	X		X	X
<i>Anaxyrus fowleri</i>	X	X	X	X	
<i>Hyla versicolor</i>	X	X	X	X	
<i>Lithobates catesbeiana</i>	X	X	X		
<i>Lithobates clamitans</i>	X	X	X	X	X
<i>Lithobates palustris</i>	X		X	X	
<i>Lithobates sphenoccephala</i>	X		X	X	X
<i>Pseudacris crucifer</i>	X	X	X	X	X

Table 2. Visual encounter/egg mass survey locations and species documented in the Chesapeake and Ohio Canal, 2011.

Site	Wetland	<i>Ambystoma maculatum</i>	<i>Lithobates Sylvatica</i>
Chesapeake and Ohio Canal	CHOHVP1		
Chesapeake and Ohio Canal	CHOHVP2	X	
Chesapeake and Ohio Canal	CHOHVP3	X	X
Chesapeake and Ohio Canal	CHOHVP4	X	X
Chesapeake and Ohio Canal	CHOHWET01		X
Chesapeake and Ohio Canal	CHOHWET02		
Chesapeake and Ohio Canal	CHOHWET03		
Chesapeake and Ohio Canal	CHOHWET04		
Chesapeake and Ohio Canal	CHOHWET05		
Chesapeake and Ohio Canal	DCFWDCH05		

Table 3. Species locations and habitat types for species present in the Chesapeake and Ohio Canal during artificial cover surveys, 2011.

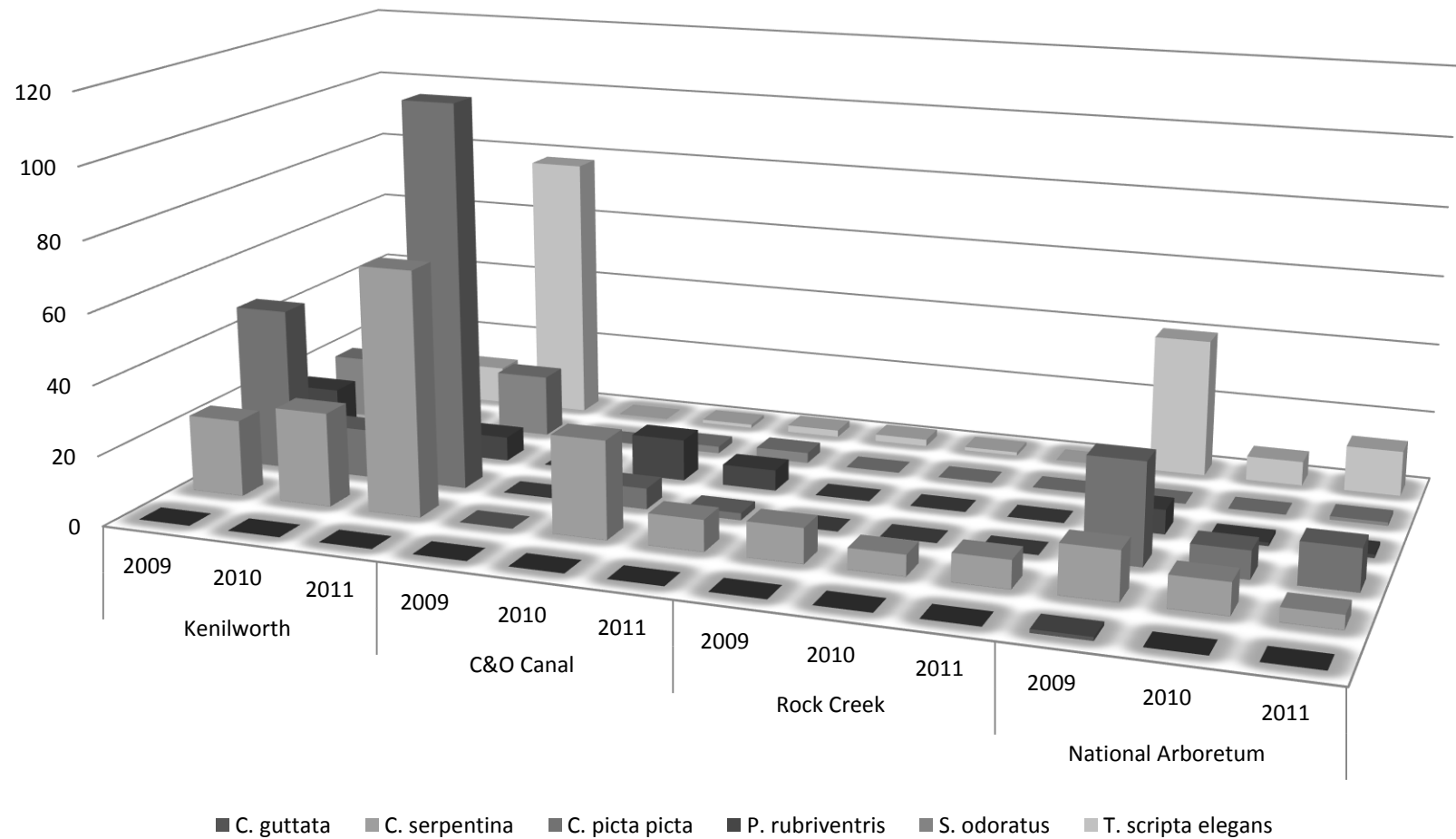
Site	Plot	Species
Chesapeake and Ohio Canal	DMSS	<i>Thamnophis sirtalis</i>
Chesapeake and Ohio Canal	WMHF	<i>Lithobates sphenoccephalus</i>

Table 4. Incidental findings of species in the Chesapeake and Ohio Canal during the 2011 field season.

Date	Location	Species	SGCN	Observed
4/26/2011	Chesapeake and Ohio Canal	Cheyltra serpentina		In wetland
6/6/2011	Chesapeake and Ohio Canal	Elaphe obsoleta		In meadow
6/8/2011	Chesapeake and Ohio Canal	Anaxyrus fowerli	X	On towpath
6/8/2011	Chesapeake and Ohio Canal	Anaxyrus americanus	X	On towpath
6/8/2011	Chesapeake and Ohio Canal	Pseudemys rubiventris	X	Nesting along towpath

APPENDIX B
FIGURES

Figure 1. Actual captures of freshwater turtles in the District 2009-2011



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APPENDIX C

For the six anuran species detected in the nighttime frog call surveys at the Chesapeake and Ohio Canal during 2011, the top five models using Akaike's Information Criterion (AIC).

Species	Occupancy Factors					Detection Factors						
Models		Distance to Road	Hydroperiod	Habitat		Day	Temp	Minutes After Sunset	Moon	Noise	AIC	Weight
Anaxyrus americanus												
1	1	0	0	0	0	0	0	0	1	0	87.83	0.1347
2	0	0	1	0	0	0	0	0	1	0	88.17	0.1136
3	1	0	0	0	0	1	0	0	0	0	88.19	0.1125
4	0	1	1	0	0	0	0	0	1	0	88.31	0.1059
5	0	1	0	0	0	1	0	0	0	0	88.51	0.0959
Anaxyrus fowleri												
1	1	0	0	0	0	1	0	0	0	0	104.59	0.2708
2	0	0	1	0	0	1	0	0	0	0	107.49	0.087
3	0	1	0	0	0	1	0	0	0	0	108.38	0.0557
4	0	0	0	1	0	1	0	0	0	0	108.49	0.0528
5	0	1	1	0	0	1	0	0	0	0	109.2	0.037
Hyla versicolor												
1	0	0	0	0	0	1	0	0	1	0	153.28	0.5011
2	0	1	1	0	0	1	0	0	1	0	154.68	0.2488
3	1	0	0	0	0	1	0	0	1	0	155.57	0.1595
4	0	1	1	0	0	1	0	0	0	0	157.44	0.0626
	0	1	1	1	0	5	0	0	0	0	160.74	0.012

Continued.

Lithobates catesbeiana													
1		0	0	0	1	0	1	0	0	0	0	68.75	0.422
2		0	0	0	1	0	1	0	0	1	0	69.67	0.2664
3		1	0	0	0	0	1	0	0	0	0	70.76	0.1545
4		0	0	1	0	0	1	0	0	0	0	71.7	0.0965
5		0	0	1	1	0	1	0	0	0	0	74.45	0.0244
Lithobates clamitans													
1		0	0	0	1	0	1	0	0	1	0	117.4	0.49
2		0	1	0	1	0	1	0	0	1	0	119.24	0.1953
3		0	0	1	1	0	1	0	0	1	0	120.56	0.1009
4		0	1	1	1	0	1	0	0	1	0	120.65	0.0965
5		0	1	1	1	0	1	1	0	1	0	122.5	0.0383
Pseudacris crucifer													
1		0	0	1	0	0	1	0	1	1	0	189.12	0.2714
2		0	0	1	0	0	1	0	1	0	0	189.48	0.2267
3		0	0	1	0	0	1	0	0	1	0	190.08	0.01679
4		0	0	1	0	0	1	0	0	0	0	190.75	0.1201
5		0	0	1	0	0	1	0	0	0	1	192.45	0.0513

The top five models using Akaike's Information Criterion (AIC) for visual encounter/egg mass surveys during 2011.

Species		Occupancy Factors				Detection Factors						
Models		.	Flood Potential	Hydroperiod	Distance to Road	Sky	pH	Water	Temperature	Observer	AIC	Weight
Ambystoma maculatum												
1		0	0	0	1	1	1	0	1	0	29.72	0.3908
2		0	1	0	1	1	1	0	0	0	30.82	0.2255
3		0	1	0	0	1	1	0	0	0	31.59	0.1534
4		1	0	0	0	1	1	0	0	0	32.64	0.0908
5		0	0	0	1	1	0	0	0	0	33.77	0.0516
Lithobates sylvatica												
1		0	0	0	1	0	0	0	0	1	14.59	0.1739
2		1	0	0	0	0	0	1	0	0	14.71	0.1638
3		1	0	0	0	0	0	1	0	1	15.55	0.1076
4		0	0	0	1	0	0	1	0	1	15.55	0.1076
5		1	0	0	0	0	0	0	0	1	15.64	0.1029

For the two species detected in the artificial cover surveys during 2011, the top five models using Akaike's Information Criterion (AIC).

Species		Occupancy Factors				Detection Factors						
Models		.	Distance to Trail	Distance to Road	.	Wind	Canopy	Temp	Day	Rain	AIC	Weight
Lithobates sphenoccephalus												
1		0	1	0	1	0	0	0	0	0	15.79	0.2311
2		0	0	1	1	0	0	0	0	0	16.19	0.1892
3		1	0	0	1	0	0	0	0	0	16.36	0.1738
4		0	1	1	1	0	0	0	0	0	17.2	0.1142
5		1	0	0	0	0	0	0	0	1	18.37	0.0636
Thamnophis sirtalis												
1		1	0	0	0	1	1	0	0	0	53.87	0.262
2		1	0	0	0	1	1	0	0	1	54.34	0.2071
3		0	0	1	0	1	1	0	0	0	55.55	0.1131
4		1	0	0	0	1	1	1	0	1	55.61	0.1097
5		0	0	1	0	1	1	0	0	1	56.09	0.0863